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Friday energy letter

풍력발전기술 로드맵

KIER 한국에너지기술연구원
KOREA INSTITUTE OF ENERGY RESEARCH

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* 출처 : 'Technology Roadmap - Wind energy' - IEA (2010)

1. 핵심 시사점

○ 본 로드맵은 2050년 전세계 발전량의 12%를 풍력발전이 차지하는 것을 목표로 함. 풍력발전의 설치용량은 2,016 GW이며, 풍력발전에 의한 연간 이산화탄소 저감량은 2.8 gigatonnes of CO_2 equivalent로 전망함.

○ 현재 풍력발전시장의 선도국가는 중국과 인도를 비롯한 OECD 회원국이나, OECD 비회원국의 풍력발전량이 전 세계 풍력발전에서 차지하는 비중은 2030년 17%에서 2050년 57%로 급격하게 증가할 것으로 전망함.

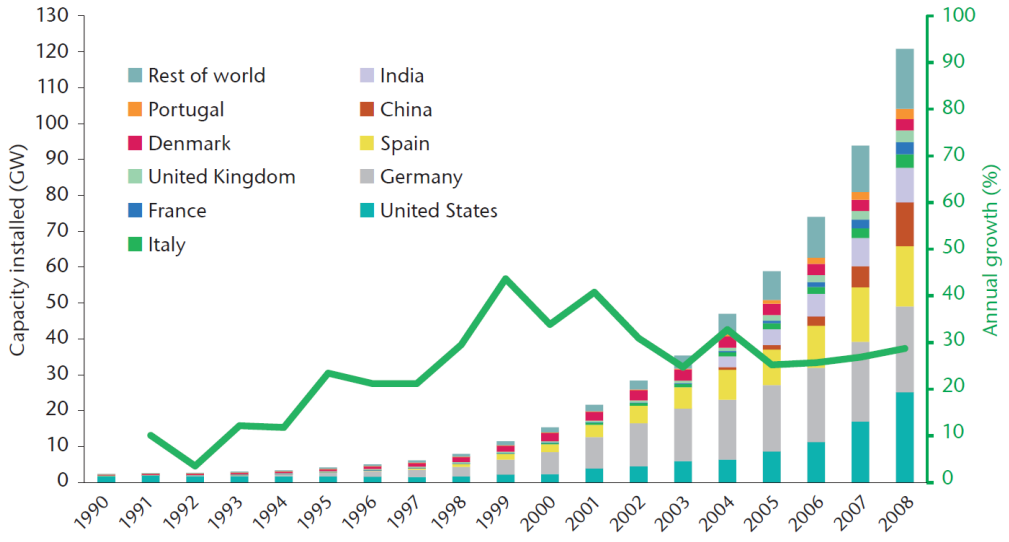
○ 육상풍력 발전기술은 이미 증명된 기술로서 풍력자원 풍부하며, 탄소 비용이 반영되는 시장에서는 이미 가격경쟁력을 확보한 상태임. 풍력발전비용은 70~130 USD/MWh 수준이나, 기술개발과 대량생산에 따른 규모의 경제 달성으로 투자비용은 2050년까지 현재수준 대비 23%가량 저감될 것으로 전망함.

○ 해상풍력은 상용화를 위하여 추가 기술개발이 필요한 상태이며, 투자비용은 현재 육상풍력 대비 2배 정도의 수준이나 발전품질은 50%가량 우수함. 본 로드맵은 2050년까지 약 38% 수준의 비용저감이 가능할 것으로 전망함.

○ 풍력발전 보급확대를 위해서는 스마트그리드와 같은 기술개발을 통하여 전력계통의 유연성을 높이고 시장규모를 확대하여 규모의 경제를 달성하는 것이 필요함.

2. 전세계 누적 풍력 발전 용량

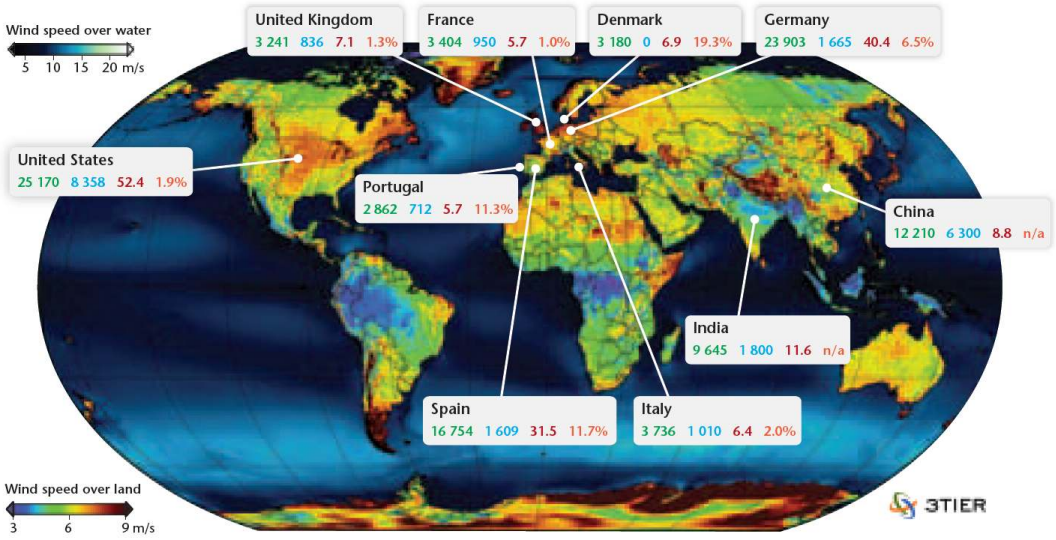
○ 풍력 발전용량은 지수적으로 증가해왔음



Source: IEA (2008a).

3. 선도국가별 설치용량 및 발전량

○ 미국, 독일, 스페인, 중국 그리고 인도 등이 시장 선도 국가임



Note: 80 m height and 15 km resolution.

Source: Resource data from 3Tier; production and capacity data from IEA, IEA Wind.

4. 육상/ 해상 풍력발전별 비용분석

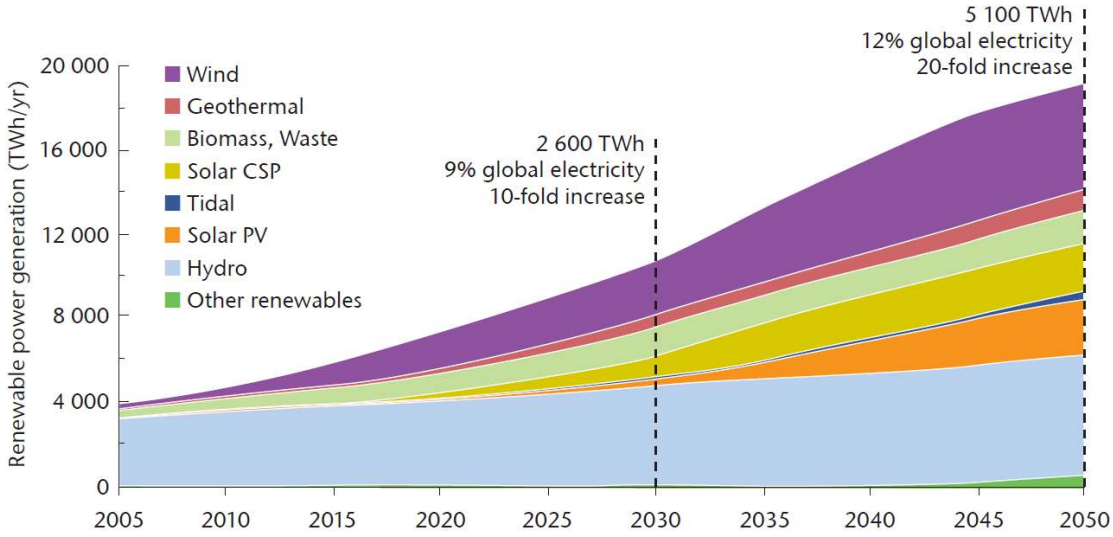
○ 풍력발전의 life cycle cost of energy (LCOE)을 저감하는 것이 연구개발의 핵심 목표임

	Onshore wind	Offshore wind
Investment costs	USD 1.4 to USD 2.6 million/MW (EUR 0.98 to EUR 1.9 million/MW) (*Europe, US costs*)	USD 3.1 to USD 4.7 million/MW (EUR 2.1 to EUR 3.2 million/WM)
Operation and maintenance costs (O&M)	USD 12 to USD 32/MWh (EUR 8 to EUR 22/MWh)	USD 21 to USD 48/MWh (EUR 14 to EUR 48/MWh)
Lifecycle cost of energy (LCOE)	USD 70 to USD 130/MWh (EUR 50 to EUR 90/MWh)	USD 110 to USD 131/MWh (EUR 75 to EUR 90/MWh)

Source: IEA analysis

5. 신재생에너지원에 의한 발전량 전망

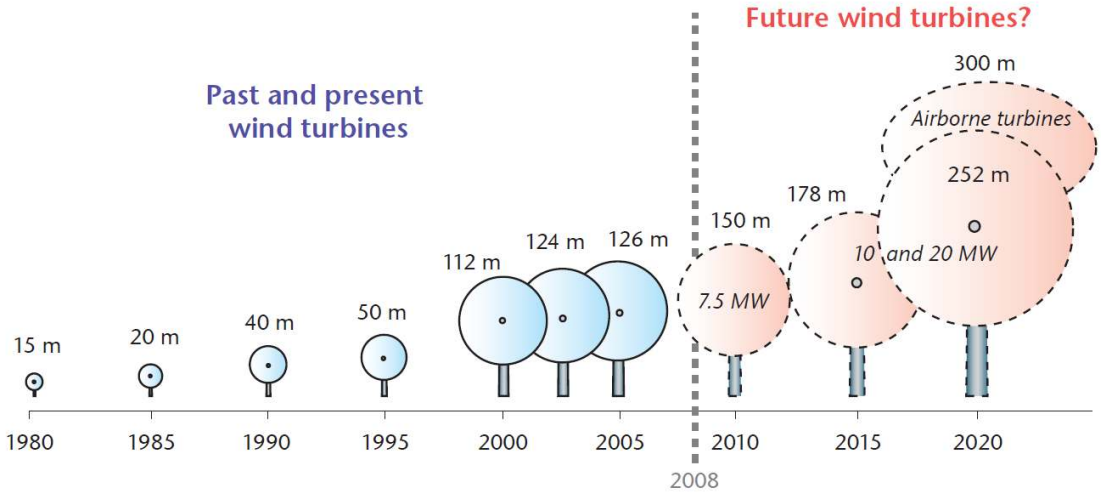
○ 풍력발전량은 2008년 대비 2030년 10배, 2050년 20배 증가할 전망



Source: IEA (2008a).

6. 풍력발전기 크기에 대한 전망

○ 보다 큰 발전기 개발을 위해서는 보다 높은 질량 대비 강도를 갖는 신물질의 개발이 필요함.



Source: Adapted from EWEA (2009).

7. 풍력발전기 개발업체 측면에서의 마일스톤

Resource	Milestones and actors
1. Refine and set standards for wind resource modelling techniques, and site-based data measurement with remote sensing technology; improve understanding of complex terrain, offshore conditions and icy climates.	Ongoing. Complete by 2015. Wind industry and research institutions, climate and meteorological institutions.
2. Develop publicly accessible database of onshore and offshore wind resources and conditions, with the greatest possible coverage taking into account commercial sensitivities.	Complete by 2015. Industry and research institutions.
3. Develop more accurate, longer-horizon forecast models, for use in power system operation.	Ongoing. Complete by 2015. Industry, research institutions and system operators.
Technology	
4. Develop stronger, lighter materials to enable larger rotors, lighter nacelles, and to reduce dependence on steel for towers; develop super-conductor technology for lighter, more electrically efficient generators; deepen understanding of behaviour of very large, more flexible rotors.	Ongoing. Continue over 2010-2050 period. Industry and research institutions.
5. Build shared database of offshore operating experiences, taking into account commercial sensitivity issues; target increase of availability of offshore turbines to current best-in-class of 95%.	Complete by 2015. Wind power plant developers, owners and operators, industry associations.
6. Develop competitive, alternative foundation-types for use in water depths up to 40 m.	Ongoing. Complete by 2015. Industry and research institutions.
7. Fundamentally design new generation of turbines for offshore application, with minimum O&M requirement.	Commercial scale prototypes by 2020. Industry and research institutions.
8. Develop deep-water foundations/sub-surface structures for use in depths up to 200 m.	Ongoing. Complete by 2025. Industry and research institutions.
Supply chains	
9. Accelerate automated, localised, large-scale manufacturing for economies of scale, with an increased number of recyclable components.	Ongoing. Continue over 2010-2050 period. Industry.
10. For offshore deployment, make available sufficient purpose-designed vessels; improve installation strategies to minimise work at sea; make available sufficient and suitably equipped large harbour space.	Sufficient capacity by 2015. Wind industry, shipping industry, and local governments.
Environment	
11. Improve techniques for assessing, minimising and mitigating social and environmental impacts and risks.	Complete by 2015. Industry, research institutions, governments, and NGOs.

8. 발전업체 측면에서의 마일스톤

Transmission development	Milestones and actors
1. Develop interconnection-wide transmission infrastructure plans in concert with power plant deployment plans.	Complete by 2015. Transmission companies, system operators, government, regulators and industry.
2. Develop and implement plans for continental-scale transmission overlays to link regional power markets.	Complete plans by 2015. Achieve deployment by 2030. Transmission companies, system operators, government, regulators and industry.
3. Develop and implement plans for offshore grids, linking existing transmission lines, offshore wind resources and bordering power markets.	Complete plans by 2015. Achieve deployment by 2030. Transmission companies, system operators, government, regulators and industry.
Power systems and markets	
4. Develop methods to assess the need for additional power system flexibility to enable variable renewable energy deployment; carry out grid studies to examine the opportunities, costs and benefits of high shares of wind power integration.	Complete by 2015. System operators and research institutions.
5. Accelerate development of larger-scale, faster and deeper trading of electricity through evolved power markets and advanced "smart grid" technology.	Continue over 2010-2050 period. Regulators and system operators.
6. Incentivise timely development of additional flexible reserves, innovative demand-side response and storage; build demand for clean energy by labelling.	Continue over 2010-2050 period. Regulators and system operators; regulators, environmental NGOs and consumer groups.
7. Assess grid codes and ensure open access to transmission networks for independent power producers, where not already available.	Complete by 2015. Regulators, system operators and wind industry.

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